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KNOWLEDGE CLIP AS INNOVATIVE PEDAGOGY: IT'S EFFECTIVENESS ON STUDENT ENGAGEMENT AT HIGHER SECONDARY SCHOOL LEVEL

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ABSTRACT

Video-based teaching is a recent trend in modern pedagogy, including first-party (instructor-created) and third-party (online available) videos. Knowledge clips (KCs) are 5-6 minutes of instructor-created videos designed by keeping in mind students' attention spans and learning needs. This study aimed to investigate the effectiveness of Knowledge-Clip on students' in-class Cognitive, Emotional, and Behavioral engagement at the Higher Secondary School level. Moreover, a comparison of the engagement level of students among the control and experimental group was also investigated before and after an intervention. This study used a mix-method approach followed by a Quasi-experimental research design and pre and post-test design. As a research sample, n=86 Biology students from one college of Rawalpindi were selected through a purposive and convenient sampling technique. Quantitative data analysis was done by using both descriptive and inferential statistics. Whereas, Qualitative data analysis was done through thematic analysis. The study's findings indicated the effectiveness of KCs on students' in-class Cognitive, Emotional, and Behavioral engagement at the HSSC level. Teachers are recommended to create colorful and appealing KCs with thought-provoking questions to improve students' engagement level at the HSSC level. Furthermore, training regarding the utilization of easy software (PowerPoint) for creating KCs may be arranged for teachers.

Keywords: Knowledge clip; Students engagement; Cognitive engagement; Emotional engagement; Behavioral engagement; Higher secondary school level.

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INTRODUCTION

Educational Technology is growing day by day, three of its distinctive generations have passed, and now, the fourth one is emerging. This generation focuses on enhancing the students' interaction with their learning environment and materials by utilizing technology-based pedagogies (Murillo-Zamorano et al., 2019). Teachers also have a positive attitude toward integrating Information Communication Technologies (ICT) in education (Arkorful et al., 2021). Every country aims to develop its future generation in a way through which they become able to survive in the ever-changing needs of society and attain success in the country's development (Malik, 2018).

In Higher Secondary Schools in Pakistan traditional approach to teaching (lecture method) is more common. Students are passive learners in this approach, which is why their classroom engagement in terms of cognitive, behavioral, and emotional engagement may be less. To enhance students' engagement, teachers can use more technology-based pedagogies in their teaching. Some teachers also use third-party

videos (YouTube videos) for delivering a concept, but the drawbacks associated with these videos are a lack of teachers' teaching style, difficulty in understanding language, and difficulty altering the needs of the students.

On the contrary, knowledge clips are first-party videos that can be pre-recorded by the instructor personally by considering students' needs, which might enhance students' engagement in the classroom. It can be more effective if we use it by combining it with other learning activities (Van Puffelen & Van Berkum, 2018). Moreover, Knowledge Clip differs from third-party videos because it is more specific, focused on a single subject/topic, and has many didactic goals (van Puffelen & van Berkum, 2018). Furthermore, the utilization of Knowledge clips is interesting, engaging and aids students in learning and understanding the concepts (Alpert, 2016). In addition, Knowledge clips play an important role in making students independent learners (Suhonen & Tiili, 2016). That is why the researcher wanted to investigate the effectiveness of using Knowledge-clip on students' engagement at the higher secondary school level. In this study researcher only examined classroom engagement as a component of students' engagement, and within classroom engagement researcher specifically investigated students' cognitive engagement (CE), emotional engagement (EE), and behavioral engagement (BE).

Theoretical and Conceptual Framework

The current study was based on engagement theory, the most appropriate framework for testing students' engagement using technology-related pedagogies. It argues that technological instruments and systems facilitate students' cooperation, involvement, and engagement. Moreover, technological tools can enhance students' engagement in different ways, and we are unable to achieve that without utilizing technology (Kearsley & Schneiderman, 1998). This theory provided a strong background for investigating the effectiveness of Knowledge clip on students in-class engagement because knowledge clip is a technological tool, and they might enhance students' engagement within the class.

In addition, the Campus-Class-Technology (CCT) model given by Gunuc (2014) was also used because this model indicated a strong positive association between technology used in the class and students' engagement. Moreover, it also indicated that effective integration of technology is necessary for enhancing students' classroom engagement. It will lead to positive outcomes and helps in increasing students' academic achievement. For the current research study, the researcher only followed the classroom engagement dimensions of the CCT model, which were Cognitive, Emotional, and Behavioral engagement. Cognitive engagement is related to students thought processes and understanding of concepts. Emotional engagement relates to students' likeness/dislikeness towards the learning activities and pedagogy. Furthermore, behavioral engagement is related to the extent students take part in learning activities. The researcher investigated the Knowledge clip's effectiveness in all three dimensions. The conceptual framework of the study is given in Figure 1.

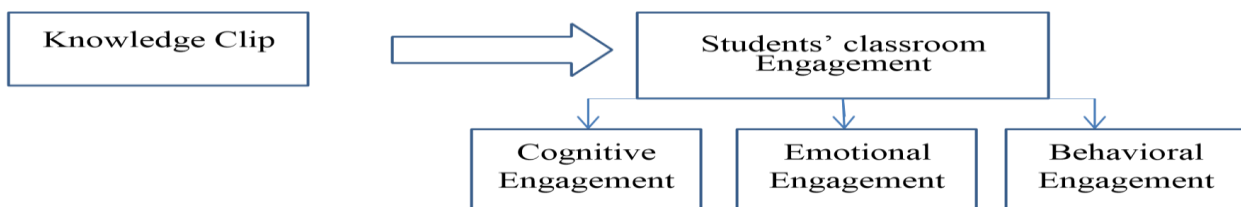


Figure 1. Conceptual framework.

LITERATURE REVIEW

The educational field is not behind in getting the benefits of new technological innovations. It is indicated that ICT enhanced students' creativity, understanding, achievement, and engagement (Comi et al., 2017; Unal & Cakir, 2021). As a developing country, Pakistan needs to bring a change in the educational sector, and in this context, ICT is being served as a tool for making improvements. National Education Policy Framework 2018 indicated that Pakistan is concerned about using ICT in education because it wants to improve the education system and achieve better results. Although National education policies favor ICT usage in education, we still face challenges in implementing those policies because traditional teaching methods are still common in Pakistan.

Most teachers are still adopting the lecture method; however it has various drawbacks included students' inactiveness in the classroom and only communication on the part of the teacher which cause students' least participation and they forget the concepts in less time (Raja, 2018). Furthermore, most of the students do not get engaged within the class and do not pay attention to what their teacher told them. In contrary to this, modern methods of teaching are following the constructivists' approach. In this approach the focus is on involving students, monitoring their progress, motivating them to take part in learning activities and interacting with learning materials and their peers (Lam et al., 2021).

Digital learning or online learning is also a part of modern teaching methods which involves online means. Recently, flipped classroom approaches and blended learning approaches are the most common forms of modern online pedagogies. The flipped classroom is a shift of in-class and homework paradigm because students watch concept-based videos from home and in-class time is utilized by the teacher for conducting activities only. In contrary to this, in the blended learning approach, both in-class and online interactions are involved but no shift of classroom homework paradigm is involved (Kintu et al., 2017).

Recently the most important learning tool of the 21st century is video or video-based lectures (Inman & Myers, 2018). Videos are playing an important role in facilitating various online courses because of this in blended learning approach teachers can use effective videos for content delivery (Duzenli, 2018). Moreover, videos can also be used to capture a lecture, demonstrate a skill, or make animated films (Woolfitt, 2015). Various kinds of videos are available among those Knowledge Clip is an effective form of the instructional video, which can be made by the instructor. It is a 5-10 minutes' video clip, through which a teacher tries to achieve didactic goals (Guo et al., 2014).

Moes and Young (2013) suggested that Knowledge clips can be introductory clips, skill demonstration clips, and modeling problem solution clips. Knowledge Clip is effective because it is easy to understand, time efficient in terms of teaching, activities and question/answer sessions, efficient in providing answers to students' questions, helps in problem-solving, and convenient to watch (Schwartz, 2013). Furthermore, by utilizing a Knowledge clip effectively we can promote independent learning among students which makes students more responsible (Moos & Bonde, 2016).

Among various fields of educational psychology, one of the most important study fields is students' engagement. Some people believes that engagement is just being active in a task but student's feelings related to the task and their willingness to do a task are also a part of student's engagement (Pachler et al., 2019). Student engagement is considered as a multi-dimensional term, classroom engagement and campus engagement are considered as major two dimensions of students' engagement.

Cognitive engagement (CE), Emotional engagement (EE) and behavioral engagement (BE) are important components of classroom engagement (Gunuc & Kuzu, 2015). Cognitive engagement includes that how well

a student is investing in his learning and to what extent he is giving value to the learning needs, learning goals, and how he plans to achieve those goals (Ben-Eliyahu et al., 2018). Whereas, emotional engagement includes feelings, attitude, and interest of students towards learning and their responses towards teachers, peers, and overall course content. In addition to this, behavioral engagement refers to students' participation in in-class activities, how much a student is putting efforts into learning and to what extent he is attending the classes (Yu et al., 2019).

The role of video is considered as effective in enhancing students' engagement. The video promotes student-centered learning which in turn enhances students' engagement (Lee & Hannafin, 2016). A positive significant relationship between student engagement and technology-based pedagogies that utilize videos was also found (White et al., 2019). Teachers can also use videos in Biology classes because they are more engaging for students. Same as Stockwell et al., (2015) concluded that videos are much engaging for students that is why these are of much importance for students' preparations in Biology classes. Moreover, it helps the instructor to convert hard abstract concepts into more visualizing concepts that can be easily understandable and engaging for students (Dash et al., 2016).

A research study conducted by Cherif et al., (2014) also indicated that students were engaged and liked to learn from YouTube videos but they wanted their teacher to provide them the link of most relevant YouTube videos to save the searching time. Furthermore, YouTube videos grasped students' attention, engaged them in learning activities, and also motivated low-performing students to show good results. In addition to this, another study conducted by Fan et al. (2018) indicated that by using video-based instructions a great improvement in students' Biology conceptual understanding has been observed. It is analyzed from these studies that teachers can carefully inculcate videos in their Biology classes to improve the overall classroom engagement of students.

The review of the literature indicated that KC could be used as a content delivery tool instead of long lectures. Moreover, a teacher can use his/her teaching style and can set the KC as per the needs and abilities of the students. To investigate the effectiveness of YouTube videos and Animated videos on students' academic performance, academic achievement, and engagement in Science classes, including Biology' various researchers have been conducted both internationally and in the Pakistani context (Alam et al., 2017; Cherif et al., 2014; Dash et al., 2016; Fan et al., 2018; Firat et al., 2021; Stockwell et al., 2015).

One of the studies also indicated that students were not satisfied with YouTube videos because it takes a lot of time to search for the most relevant video. Furthermore, another study utilized videos/puzzles etc. and investigated their effects on students' science achievement. The results of the study indicated balanced scores among control and experimental groups but significant improvement in pre-test and post test scores of the students (Firat et al., 2021).

Moreover, instructor-created videos have been used to check their effectiveness in online and face-to-face interactions only in international contexts (Van Puffelen & Van Berkum, 2018). But, as per my limited knowledge, none of the research studies has been conducted that specifically investigated the effectiveness of using Knowledge-clip on students' engagement in the Pakistani context and for Biology students at HSSC level. That is why the current research study was conducted to investigate the effectiveness of using Knowledge-clip on students' engagement at the HSSC level.

METHODOLOGY

This study used experimental research designs. Specifically, a quasi-experimental research design was used by following a non-equivalent comparison group design and non-equivalent groups pre-test and post-

test design. Moreover, mix-method including questionnaires, observational checklists, and open-ended questions was used for data collection. Two experts in the field validated the instruments. Factor analysis was used to check the construct validity of the instrument. The instrument's reliability was checked by pilot testing and calculating the cronbach alpha coefficient by using IBM SPSS 21.0. The target population of the study was N=110. Whereas the study sample was n= 86, selected through purposive and convenient sampling technique. The researcher followed the following steps and sequences in this study as shown in Table 1.

Table 1. Steps done during quasi-experiment.

<ol style="list-style-type: none">1. Gave a Pre-test (Students Course Engagement Survey) to 86 students.2. Matched participants based on their engagement level scores. The range of scores was (Below Average 2.87-3.33, Average 3.34, Above Average 3.35-3.78).3. Selected one group as a Treatment group through a non-random method (matching strategy).4. Selected one as a Control group through non-random method (matching strategy).5. Taught Treatment group by using Knowledge clip.6. Taught Control group without using Knowledge clip.7. Another teacher did classroom observations (For avoiding Biasness).8. Took post-test (Students Course engagement survey) for both groups.

Instrument

Two questionnaires were adapted and merged; Student Course Engagement Questionnaire (Handelsman et al., 2005) created for college students and Students' experience of engaging with the animated videos (Liu and Elms, 2019). The total number of items in the questionnaire was 23, with six open-ended questions, two for each domain (cognitive, emotional, and behavioral engagement). Two experts checked the construct and content validity of the instrument; moreover, confirmatory factor analysis (CFA) was done on data from pilot testing by connecting IBM SPSS 21.0 with AMOS. The results of CFA indicated that CFI value= 1.000 and GFI value= .926, which is above the threshold value of 0.9. Whereas RMR value= .000 and RMSEA value= .000, which is less than the threshold value of 0.05. Whereas the p-value= .746, which is insignificant. All of these values indicate that the hypothesized model is a good fit for the data. On the other hand, the instrument's reliability was checked by using Cronbach's alpha coefficient, and the alpha value was .931, indicating that the tool was highly reliable.

DATA ANALYSIS

Quantitative data analysis of this study was done by applying an independent t-test, dependent t-test, and percentages. To check whether the independent t-test and dependent t-test are appropriate for the data set, the researcher checked the assumptions for running both tests. Whereas for qualitative data, thematic analysis was done.

Data Analysis for Quantitative Part (Questionnaire)

Between Group Post-Test Comparison

To compare the students' engagement after teaching the treatment group using Knowledge Clip and the control group using the traditional lecture method, the researcher compared post-test scores by applying an Independent t-test. The results of the post-test comparison between groups are described below:

Table 2. Independent sample t-test results for post-test of students' engagement.

Variable	N	Mean	Df	t-value	p
Control group	43	3.26	84	-8.504	.000
Experimental group	43	4.15			

In Table 2, the mean score for the control group is $M=3.26$, and for the treatment, the group is $M=4.15$ which is higher than the mean score of the control group. In addition to this, the p-value is .000 and $p < 0.05$; thus, we reject the main null hypothesis, which was there is statistically no effectiveness of Knowledge-Clip on students' engagement at the HSSC level.

Within Group Comparison for Control Group

In the control group, participants took a pre-test and post-test but did not receive treatment. For comparing the differences in students' engagement by using pre-test and post-test scores for the control group paired sample t-test or dependent t-test was used. The difference in the scores of the pre-test and post-test are described in Table 3.

Table 3. Paired sample t-test results for control group.

Pair	Mean Difference	SD	T	Sig. 2 Tailed	
Pair 1	Cognitive pre-test & post-test	.16944	.77826	-1.428	.161
Pair 2	Emotional pre-test & post-test	.29070	.73483	-2.594	.113
Pair 3	Behavioral pre-test & post-test	.04070	.97884	-.273	.786

As mentioned in the Table 3 p-value for the cognitive pre-test and cognitive post-test is .161 and $p > 0.05$; thus, the results of the pre-test and post-test indicated no significant difference in students' cognitive engagement for the control group ($M=1.69$, $SD=.78$), $t(42) = -1.43$, $p=.161$. Furthermore, the p-value for emotional engagement is $P=.113$ and $p > 0.05$; thus, the pre and post-test results highlighted no significant difference in emotional engagement of students for the control group ($M=.30$, $SD=.73$), $t(42) = -2.60$, $p=.113$. Moreover, the p-value for behavioral engagement is .786 and $p > 0.05$; thus, the pre and post-test results indicated no significant difference in students' behavioral engagement for the control group ($M=.04$, $SD=.98$), $t(42) = -.273$, $p=.786$. The results indicated that the engagement of students who taught by using the traditional lecture method remained the same in the pre-test and post-test.

Within Group Comparison for Experimental/Treatment Group

The treatment group of this study first took a pre-test and then received and, at the end, took the post-test. For analyzing the difference in the students' engagement scores before and after treatment researcher has used paired sample t-test or Dependent t-test. The difference in the scores of the pre-test and post-test for the treatment group is described in the Table 4.

The Table 4 is indicating that for cognitive engagement pre and cognitive engagement post the p-value is .000 and $p < 0.05$ thus, it is indicated that there is a significant difference in the cognitive engagement of students' before and after receiving an intervention ($M= 1.00$, $SD= .59$, $t(42) = 11.23$, $p=.000$). In addition to this, for emotional engagement-pre and post p-value is .000 and $p < 0.05$ thus, it is indicated that there is

a statistically significant difference in the emotional engagement of students' before and after the treatment provided ($M= 1.94, SD= .36, t(42) = 35.21, p=.000$). Moreover, for behavioral engagement-pre and post p-value is .000 and $p < 0.05$ thus, a significant difference among the students' behavioral engagement before and after receiving an intervention was found ($M= .67, SD= .30, t(42) = 14.85, p=.000$). The results indicated a significant difference in the pre-test and post-test scores of participants in terms of their cognitive, emotional, and behavioral engagement before and after an intervention.

Table 4. Paired sample t-test results for treatment group.

Pair	Mean Difference	SD	T	Sig. 2 Tailed	
Pair 1	Cognitive pre-test & Cognitive post-test	1.00332	.58611	11.225	.000
Pair 2	Emotional pre-test & Emotional post-test	1.94477	.36218	35.211	.000
Pair 3	Behavioral pre-test & Behavioral post-test	.67442	.29773	14.854	.000

Analysis of Observation Checklist

For validating the results of the current study, an observation checklist with 20 statements was filled by the subject teacher of students during the intervention. The detailed analysis of the observation checklist is described as under:

Cognitive engagement: Remembering, understanding, and applying attention, interest, and concentration were considered indicators of cognitive engagement. Results indicated that most participants were cognitively engaged within the Biology class; almost all of the participants were watching KC's with concentration, watching clips attentively, and whenever their teacher asked questions, most of the participants knew the answers. Moreover, it was also observed that most participants were interested in watching KC's; they were always ready to watch KC's and were listening and watching KC's carefully. Furthermore, it has been observed that all of the participants were paying attention while watching KC's. They were focused and not distracting other students. In addition to this, most of the participants were able to apply the knowledge they had gained through watching KC's. They have utilized their knowledge and understanding of the concept for effective presentations. Moreover, most of the participants understood and remembered the key concepts by watching KC's, performed well in online quizzes, explained the concept during group discussions and presentations, and correctly responded to the questions asked.

Emotional engagement: For emotional engagement, the indicators were: excitement, enjoyment, happiness, and likeness. The results indicated that all participants liked the colors, pictures and animations used in the Knowledge clips. Their response, facial expressions, excitement and interest also indicated that they liked the interface of the KC's. In addition, most of the participants liked KC's instead of the traditional method of teaching because whenever they got an option either to learn from books or KC's they always selected KC's. Participants asked the researcher to share this idea of using Knowledge Clip with their other subject teachers too. Furthermore, all of the participants liked KC's for learning Biology and usually insisted their teacher show another clip after watching one clip. Moreover, all of the participants enjoyed and were happy while watching KC's. They had a smile on their faces, looked fresh and excited, and did not look dull.

Furthermore, all of the participants were excited while watching KC's, and they had positive facial expressions. They came into the class before time, opened their systems and followed teachers' instructions quickly.

Behavioral Engagement: For behavioral engagement regularity in watching clips, completeness of clips, regularity in Biology class, follow instructions, responding to questions and no distractions were the indicators. The results indicated that majority of the participants were behaviorally engaged within the class. All of the participants were watching KC's regularly and were watching complete KC's without skipping some parts of the clips. It has been indicated because they performed well in quizzes, discussions, and presentations which was not possible until they do not watch complete KC's. Furthermore, most of the participants were attending their biology class regularly and their attendance rate for Biology class was 98%. It is also indicated that all of the participants were taking notes while watching KCs and all of the participants have completed the assigned tasks. Furthermore, all of the participants were focused, not talking to other students', not making noise and watching KC's with concentration and attention. In addition to this, most of the participants were responding to the questions within the KC's and submitted their responses to researcher. Moreover, all of the participants were following the instructions given within the KC's.

The cross-analysis of questionnaire and in-class observations indicated that results of in-class observations of participants were almost similar with individual responses of participants. It shows that whatever the students' responded within the questionnaires was true and reliable. Moreover, it has been analyzed that utilization of KCs improved students cognitive, emotional and behavioral engagement at HSSC level.

Data Analysis for Qualitative Part

The questionnaire used for data collection had six open-ended questions two for each dimension. For those questions, the responses were word-to-word transcribed, open coding and axial coding was done and extracted major themes and sub-themes for further analysis. A detailed analysis of the qualitative part is described as under in Table 5.

Table 5. Themes generated from open-ended questions.

Constructs	Major Themes	Sub-Themes
	Conceptual Understanding	Abstract to Visual conversion
Cognitive Engagement	Engaging Attention	Visual Attraction
Emotional Engagement	Best Aspects of Knowledge Clips	Combination of Pictures and Written text Different from YouTube videos Less duration Easy to remember Pictures and Animations.
	Reasons for Likeness towards Pictures/Animations of Knowledge Clips	Engaging interface Interest in Biology class Quick Speed of Knowledge clips
Behavioral Engagement	Quantity of KC's watched Reasons for Completeness of KCs	Interesting KCs Preparation for Quiz and Group discussion Informative & Short Duration

Cognitive Engagement

The first two open-ended questions for cognitive engagement were: Do you think Knowledge clip enhances your concept understanding? How? and If no, then suggest any improvements and the other question was

Do you think the Knowledge clip engaged your attention in Biology class? How? If no, then suggest any improvements. For the first two Open-ended questions participants responded that KCs engaged their attention and enhanced their conceptual understanding because in the chapter Transport in plants they cannot see anything in reality and are unable to understand that how transport occurs in the plant but within KCs pictures and good explanation of concepts were present which helped them in understanding the concept within less time. One of the participants responded:

"For me knowledge clip was interesting and the teacher used pictures and explained every concept by using arrows or pointer with every picture which enhanced my conceptual understanding"

Furthermore, Majority of the students also said that the pictures used within the KC's and the way of presentation also attracted them, grabbed their attention, and improved their conceptual understanding. They responded that usually in Biology class they only listen to their teacher and nod their heads in yes! even though they do not understand a concept within KC's the case was different because the sound of the teacher was present in the clip aligning with the visuals and pictures which grabbed their attention. In addition to this, respondents also said that while listening to the lecture they felt bored and distracted, but they were excited about watching KCs because it grasped their attention and did not let them feel bored and distracted. One of the participants responded:

"The animated pictures within the KCs took my attention because instead of imagining concepts and distracting from original concept these animated pictures seems like original and made my concepts clear"

Emotional Engagement

The open-ended questions for emotional engagement were: What do you think are the best aspects of the Knowledge clip? And did you like the animations/ pictures in the Knowledge Clip? Why? If not, then suggest any improvements. The majority of the students responded that the best aspect of the knowledge clip was a combination of pictures and text, which they liked the most because it helped them understand the concepts. Only reading a text is not that useful in understanding a concept until there is no exact image in front of the eye, same as watching an image alone without explanation is also useless. In addition to this, some of the students' specifically mentioned that they liked the written text within the KC's because the voice-over within the clips was speedy, and sometimes they found difficulty in understanding the words pronounced by the teachers and taking notes but the written text used within the clips has resolved this problem. One of the respondents said:

"Sometimes while taking notes from KCs I do not pay attention to the voice of the teacher used in the clips at that time written text used in the clips helped me in understanding the spoken phrase"

Moreover, the majority of the participants responded that KC's are different from YouTube videos because these videos normally use difficult English language and foreign accents and are without written text. They also said that some videos are totally in Urdu. They are easy to understand, but they are unable to make notes from them in English without making any errors. Whereas their teacher made KCs in easy language, she explained the concept very well by using sound, text, and animations, which helped them understand the concept, which is why they liked KCs. Furthermore, all of the participants responded that they were happy with the short duration of KCs because they lost interest during the long lecture of 45 minutes. Whereas KCs are of short duration, they felt excited, liked to watch KCs, took notes, got more time for activities, not felt bored and lost their attention within the class, which not only improved their conceptual understanding but also enhanced their excitement for attending Biology class.

The majority of the participants also responded that KCs have made it easy for them to remember the concepts quickly. They said that only listening to something takes time to remember it, but KC's sound, text, pictures, and animations helped them remember the concept more quickly. Participants also responded that they were able to pause a video and watch it over and over again, which also helped them remember a concept. One of the respondents said:

"I do not like only to listen to my teacher for remembering a concept that is why I loved the Pictures, animations, Sound, Text, and Colors of the Knowledge Clips"

Furthermore, in response to the question asked regarding likeness of pictures/Animations towards KCs majority of the respondents said that they liked pictures/ animations used within the KCs because it engaged students' attention and compelled them to put their attention towards the concepts taught. These clips also enhanced the interest of students in their Biology class. Moreover, respondents also said that they liked the colorful backgrounds, engaging interface and font size of the KCs because the color combination of the clips was attention grasping and by watching those colorful clips, they felt fresh and always ready to learn within the class, and the font size helped them in taking notes. In addition, they also responded that they liked the colorful and engaging concept maps at the end of every KC, which provided a summary of the whole concept and helped them take notes and remember concepts and solve quizzes. One of the respondents also said:

"Before watching Knowledge Clips I was personally not much interested in Biology but KC's enhanced my interest in this subject and now Biology is my favourite subject"

One of the respondents said they liked the colors, pictures, and overall interface of the KC's, but they were not happy with the speed of those clips. Their responses indicated that because of the fast speed of clips, sometimes, they are unable to understand the voice and pronunciation of the words. Moreover, they also said that due to the fast speed of clips, they faced difficulties taking notes, and they had to watch the same clip repeatedly to take exact notes.

Behavioral Engagement

The open-ended questions for behavioral engagement were: How many videos have you watched out of total? And have you watched complete videos or some part of the videos? Why? In response to these questions majority of the students responded that they watched all of the 10 Knowledge Clips. In contrast, few students' responded that due to their absenteeism in one or two classes, they watched eight or nine Knowledge Clips out of a total of ten Knowledge Clips. It is indicated that they were behaviorally engaged within their Biology class. Furthermore, participants responded that they watched complete KC's instead of some parts of KC's because they found KC's interesting. For the first time, they were learning by using computers, which was so interesting for them and compelled them to watch complete clips. In addition to this, they also responded that they wanted to have a clear conceptual understanding of the concept and also have to remember the concept explained because after watching a clip firstly, they have to fill quiz and then must have to take part in group discussions and until they do not watch complete clips they do not have enough knowledge to take part in group discussions. Moreover, they liked the short duration of KCs because a concept which their teacher used to cover in a long lecture of 45 minutes was covered in 6-7 minutes clips that is why they preferred to watch complete clips instead of skipping them. One of the respondents said:

"Once I came late in class and decided to skip some parts of KC but then I realized that right after this I need to solve quiz and take part in a group discussion so I took some extra time from teacher and watched complete KC"

Findings

The results indicated the effectiveness of Knowledge-Clip on students' engagement at the HSSC level. It is also analyzed that the students in the experimental group who taught by using Knowledge Clip were more engaged as compared to students in the control group who taught without using Knowledge Clips.

It is further indicated that the engagement level of participants remained the same in the pre-test and post-test for the control group. Whereas it is analyzed that there is a significant difference in pre-test and post-test scores of experimental groups, which showed that the student's engagement level was improved after giving an intervention using Knowledge Clips.

The results also indicated the effectiveness of Knowledge-Clip on students' cognitive engagement in Biology class at the HSSC level. It has been extracted from the results that most students found KCs' attention grasping. They said that their new Biology class is different from the older one in which they were least attentive and mostly felt sleepy. One of the respondents also claimed that before watching Knowledge clips, he was personally not much interested in Biology but after learning through KCs' Biology is now his favorite subject.

Results of the study also highlighted the effectiveness of Knowledge-Clip on students' emotional engagement at the HSSC level because they liked the Knowledge Clips, they wanted to see more Knowledge Clips in the future, their excitement, positive facial expressions, enjoyment within Biology class, and happiness also indicated their emotional engagement within Biology Class. Moreover, participants liked the combination of pictures, text, animations, the engaging interface, and the short duration of clips. On the contrary, some of the students also responded that they liked the interface of KCs' but not the speed because they felt difficulty in note-taking.

Results also indicated the effectiveness of Knowledge-Clip on students' behavioral engagement because they attended Biology classes regularly, the attendance rate was 98%, they watched KCs' regularly, they watched complete clips without skipping parts or selecting some parts, they participated in a question/answer sessions, quizzes, group discussions, and presentations. Moreover, they followed the instructions mentioned in KCs' and also took notes while watching clips, and most of the participants were; focused on their work, not distracting other students, not making noise and not talking to each other while watching KCs.

The above-mentioned results indicate that the effectiveness of Knowledge-clip for enhancing students' classroom engagement at the HSSC level is significant. Same as Griffiths (2010) also indicated that instructor-generated videos could enhance the overall engagement of students. Furthermore, the literature also supported that teachers who used technology-based pedagogies and integrated technology (including video) in class have seen a great enhancement in students' classroom engagement (Lee & Hannafin, 2016; White et al., 2019).

Discussion

This study indicated the effectiveness of Knowledge Clips on students' cognitive engagement in Biology class at the HSSC level. It is because when students watch KCs' visuals, animations, and colors of the clips compel them to pay attention, concentrate, understand, remember and apply the concept they learned, and enhance their cognitive engagement within the class. Fan et al. (2018) have used videos for teaching

Biology and indicated that videos improved students' conceptual understanding of biology concepts. Moreover, these results are akin to the previous research studies, which indicated that instead of teaching science by using the lecture method, if a teacher uses videos, students would pay more attention and concentration towards the content being taught and it will also help students in remember, understand, and applying the concept they learned in less time (Brame, 2016; Stockwell et al., 2015). The results of this study are still unique because, within the current study researcher specifically used Knowledge Clips instead of third-party videos.

Furthermore, the study highlighted the noteworthy effectiveness of Knowledge-Clip on students' emotional engagement in Biology class at the HSSC level. Knowledge Clips enhanced students' excitement, satisfaction, interest, and likeness towards Biology courses. These results are akin to a research study which indicated that students face boredom in traditional classes, and their excitement and satisfaction within the class can be enhanced by using videos. Moreover, students' interest and their likeness towards learning science through videos are because of the colorful backgrounds and animations used within the videos (Dash et al., 2016; Devlin et al., 2013; Yousef et al., 2014). Moreover, another reason why Knowledge Clip stimulates students' interest in Biology class is that students are bound to solve the quiz at the end of every KC, which is why they take extra interest in watching Knowledge Clips. Furthermore, most of the students liked the speed of the KCs. Contrary to this, one of the participants did not like the speed of KCs because he faced difficulty in note-taking, and sometimes it affected his scores on quizzes. These results are akin to the study of Uohua Pan et al. (2012), which indicated that students do not like the short duration of instructor-made videos. Whereas participants preferred KCs' over the traditional lecture method in this study, these results contradict the study of Jill et al. (2019), which highlighted that students liked to learn through instructor-generated YouTube videos but do not want to replace traditional classes with complete video-based classes.

In addition to this, the results of the study indicated the effectiveness of Knowledge-Clip on students' behavioral engagement in Biology class at the HSSC level. It is because Knowledge Clips were new for students, and they found these interesting, showed positive behaviors, showed regularity in watching KCs', showed regularity in attending classes, followed teacher instructions, responded to teachers' questions, made no distractions, and they watched complete clips instead of skipping some parts. These results are akin to the studies of Alpert (2016) and Devlin et al. (2013) which indicated that when they used instructor-based videos, the attendance rate of students was enhanced. Moreover, students who taught by traditional lecture methods were less regular in their classes as compared to students who taught by using videos. Furthermore, it is also indicated that the students who taught by using videos were more likely to follow the instructions, respond to and ask questions as compared to those who taught by using the traditional lecture method Devlin et al. (2013). Moreover, Al Mamun et al. (2016) indicated that high behavioral engagement of students was shown while watching videos in an online course because they watched all of the videos and completed all of the videos. In addition to this, Kuiper et al. (2015) highlighted that by utilizing ICT or video-based teaching approaches, teachers could develop the interest of students within class and activities, which makes them more focused and non-distracting. Contrary to this, a study conducted by Luo and Kalman (2018) utilized summary videos and indicated that there was no effect of these videos on students' behavioral engagement.

The study's overall findings are new and unique because, in previous research, the authors either used third-party videos, including YouTube videos, for exploring students' engagement within the class or used instructor-generated videos in some studies but utilized these videos for online courses only. In this study, the researcher adopted a blended learning approach for utilizing KCs, which was not used before.

Moreover, this research focused on all three dimensions of student engagement. In addition to this, the current study is a pioneer one in the Pakistani context, which is why its results are unique in comparison to the existing research held in Pakistan in the same area. Moreover, the current study has introduced a new approach to teaching in the form of Knowledge Clip which is a way forward for future researchers, and they can also explore this area in other aspects and geographical contexts.

CONCLUSIONS AND RECOMMENDATIONS

Traditional approaches to teaching are getting replaced with new and innovative approaches; among those most common these days are online approaches to teaching and learning, including blended learning, e-learning, and flipped classrooms. These new approaches are different from traditional ones and more effective in terms of enhancing students' engagement within the classroom. The most common ingredient of all these approaches is "video". Knowledge Clips are short-duration video clips that the instructor creates per the student's learning needs, along with the benefit of incorporating a personal teaching style. In this study, the researcher developed a blended Learning Biology module using KCs for HSSC students and investigated the effects on students' in-class engagement (CE, EE, BE). The study's results indicated the effectiveness of Knowledge Clip on students' engagement in Biology class at the HSSC level. Moreover, it is analyzed that the in-class engagement of students who taught using KCs was more than those who taught without using KCs. It can be used as a way to improve the quality of education in the future. The recommendations of the study are given below as;

1. Teachers may use Knowledge Clips as introductory clips in their lessons to improve their students' in-class engagement at the Higher Secondary School level.
2. Teachers may include thought-provoking questions in Knowledge Clips to improve their students' cognitive engagement.
3. Teachers may use appealing color schemes, pictures, texts, and animations in Knowledge Clips to improve the emotional engagement of their students.
4. Teachers may plan their instructions using Knowledge Clips of 5-6 minutes instead of long lectures to improve behavioral engagement of their students.
5. Teachers may create Knowledge Clips by keeping in mind the attention span of the students.
6. Teachers may create interesting Knowledge Clips to improve the behavioral engagement of their students.
7. Teachers may create Knowledge Clips at normal speed so the students can easily decode them and get enough time to take notes.
8. The biology curriculum at the Higher Secondary School level may be designed to include both Knowledge Clips and in-class activities.
9. Teachers may design blended learning modules by using Knowledge Clips for science subjects.
10. Training may be provided by the experts in the field of Education Technology or ICT in education to the teachers regarding making Knowledge Clips by utilizing easy software like PowerPoint.
11. To avoid internet connectivity issues, teachers may add all Knowledge Clips of a course in Compact Disk (CD) and provide it to students along with their syllabus in soft form.
12. To avoid internet connectivity issues, teachers may make day-wise folders in the computers of every student containing Knowledge clips and their quiz/activity of the day.
13. Curriculum developers may restrict teachers to include at least one knowledge clip for each lesson. It can be an introductory clip, a skill demonstration clip, or a problem-solving clip.

14. Teachers may use knowledge clips as problem-solving clips to improve students' higher-order thinking skills.
15. Teachers may create scenario-based Knowledge clips to improve higher order thinking skills of students.

Limitations

For the current research study researcher was only able to experiment either on girls' or boys' students. The researcher only conducts this experiment in only one boys' college because most government colleges are not coeducational in Pakistan. In addition, the researcher wanted to conduct an experimental study for fifteen days, but she got permission to conduct her experiment for only 10 days. Moreover, after three days of the experiment, the researcher faced some internet connectivity issues; instead of utilizing Google classroom for watching Knowledge Clips and solving quizzes, the researcher saved Knowledge Clips and quizzes on the computers of every student by creating Day-wise folders.

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